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MODELING AND ANALYSIS OF COCONUT SHELL GRINDING MACHINE FOR UTILIZATION OF TEMPLE WASTE FOR SPECIFIC APPLICATION AS MANUFACTURING OF INCENSE STICKS/CONES

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ABSTRACT

Temple waste generation is the one of biggest problem in developed and developing countries considering its obnoxious impact on the environment. India is severely affected by improper waste collection at source and mismanagement and various cultural and social practices practiced since the time immemorial. Especially in Indian temples various types of puja offerings generate wastes such as flowers, fruits, clothes, leaves, coconuts and other food wastes. In this study various techniques were studied and among all those available techniques using temple waste in the form of flowers and coconut shell which remains unused after offering are used for making fragrant incense sticks. For making incense sticks various parameters were considered which are convenient, economical and eco-friendly and easy to reach for the small scale and household enterprises. The desist for manufacturing incense stick could be made according to various consideration like potential of the temple waste in the form of flowers and coconuts which are the major cause of temple waste. Flower waste could be easily grind, but for grinding coconut shell more power is needed. So in this study the coconut shell grinding machine is designed by its modelling on SOLIDWORKS for 10 coconut shell having impact load of 500N by one hammer, here there is a consideration of 4 hammers so distributed 125N impact load each,, using a power source of 5.5KW.After modeling analysis is carried out on ANSYS. The result calculated as maximum equivalent shear stress of 8.23MPa and maximum equivalent elastic strain of 4.11.

KEYWORDS: Temple waste, flowers, coconut shells, grinding machine, incense sticks/cones.

1. INTRODUCTION

Temple Waste

Religion is very important part of every human being. In every religion devotees and followers of GOD are in very large population. In every religion there are different methods of pray for their God. In Hindu religion, almost all devotees have a worship place in their home to do puja of their deity. Even than they used to visit temple daily as a part their routine schedule. These prayers are not done by free hands. During pray devotees used to offer some items like flowers, coconuts, fruits, baelpatra, sweets, ghee, oil, dry fruits, clothes, chunries, etc., out of these offering fruits,sweets are eaten in the form of parsad, but flowers, baelpatra, and coconuts are becomes waste because once offered cannot be reused, so these are called Temple waste.

Types of Temple Waste

- Flowers
- Coconuts
- Bael Patra

Ways of Disposal of Temple waste

- By Store Room storage
- By Thrown in Bins
- By Thrown in Open areas
- By Burning
- By Throwing in Water

Overview of Coconut Shell Grinding Machine

Coconut shell grinding machine is a type of hammer mill . This hammer mill is an impact mill employing a high speed rotating disc, to which there are fixed a number of hammer bars which are swung outwards by centrifugal force. Material is feeding, either at the top or at the Centre, and it is thrown out centrifugally and crushed by being beaten between the hammer bars, or against breaker plates fixed around the periphery of the cylindrical casing. The hammer mill crushes by the collisions between high-speed hammer and material, and the hammer crusher features in its simple structure, high reduction ration, high efficiency, etc.

Working Principle

The hammer mill is based on the principle of centrifugal force and impact load by hammers. As the material is fed to the grinding camber the impact load is acted on the coconut shells by hammers and due to rotation of hammers the centrifugal firce throw the material to the teethed wall. due to this action material is crushed between the fixed teeths and hammer into small size of 3-5mm or as per requirement.then this crushed material is throw down and is allow to passed through screens/grates mounted on lower part of the grinding chamber. After passing through screen the material is collected through bottom opening which is throw down due to gravity force.

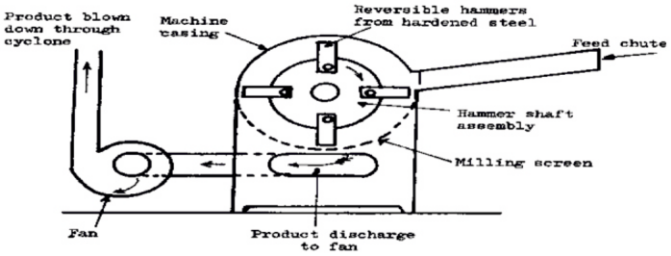


Fig. 1 Coconut shell grinding machine

Features

- In THIS machine Material is reduced by impact from free-swinging bar hammers.
- Finished Product size controlled by grates or screen sizes.
- Materials can be reduced to granular powder at high rate.
- Heavy-duty cast-iron or carbon steel construction.

Advantage

- Best possible power to output ratio.
- Easy change of screen & hammers
- Hammer mill produces ultrafine particles and yields narrow size distribution.
- It is simple to install and operate.

Disadvantage

- Its main drawback is its lack of versatility.
- Very small materials is hard to grind.
- Wet material is also difficulties to grind.

2. LITERATURE REVIEW AND PROBLEM FORMULATION

Hadi Muhammad Ibrahim et al. (2017) In this paper author has described the Improvement on the Design, Construction and Testing of Hammer Mill [1]

Nisha Jain (2016) In this paper author has studied the management of organic waste by vermicomposting.[2]

Kodwo Miezaha et al. (2015) In this paper author has studied about the reliable waste management data which can be used as the average estimate for making various waste management methods and techniques.[3]

R. Udhayasankar et al. (2015) In this paper author has studied the use of natural

fibers as biodegradable bio-composite material [4]

G. Gopal et al. (2014) In this paper author describes about the dynamic analysis on hammer of a coal-hammer mill crusher.[5]

Ajaka E.O. et al. (2014) In this paper author has studied the design, fabrication and testing of a laboratory size hammer mill. [6]

P. S. Masure et al. (2014) In this paper author has studied about the flowers waste which can be used for extraction of colourful dyes to be used in textile Industry. [7]

E.Vijaya Kumar (2013) In this paper author has studied the Design and analysis of shaft and rotor assembly for hammer mill crusher. [8]

Maninder Kaur et al. (2012) In this paper author has studied about the utilization of coconut shell as coarse aggregates in mass concrete. [9]

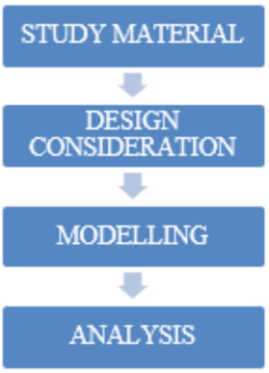
Problem Formulation

Among the various ways described in the various studies and research paper's review burning of temple waste causes environment pollution and throwing in water bodies causes water pollution in a large percentages. So to minimize these large percentage there is a need to find the convenient way of utilizing temple waste as manufacturing of automatic incense stick/cones making machine. For this potential of temple waste was find out by doing survey which was calculated as 65% flowers and 30% coconut shells. After finding the potential of the temple waste next is to convert it into powder form, than the calorific value were calculated as 3500-4000 kcal/kg for flowers and 4278.20 kcal/kg for flowers to make incense sticks/cones. So a machine is needed to be made as per the potential find out. By various research papers reviews there is a hammer mill type machine design is considered and a model of that machine could be made for utilizing temple waste for manufacturing incense stick/cones, which is as coconut shell grinding machi

3. OBJECTIVES

- A contribution towards Swachh Bharat Abhiyan.
- To characterized the temple waste.
- To find out the methods of disposal of temple waste.
- To provide a convenient and quick method of incense stick manufacturing.
- To design and modelling a cheap and best automatic incense stick manufacturing machine including Grinder.
- To provide eco-friendly way for reducing the amount of water pollution, air pollution and environment pollution.
- To make a low cost and small sized coconut shell grinding machine to utilize temple waste in temple premises for making incense sticks/cones.
- To provide employment facilities to local residents by setting up small scale factory or enterprises
- To utilize the flower waste and coconut shell waste for manufacturing of incense sticks by replacing saw dust wood powder to minimize production cost.

4. MATERIALS AND METHODOLOGY



Study Material

The material used for Rotor shaft, Rotor Disc, Hammer head and hammer arm is Structural Steel S275

Design Consideration

To break the shell of a coconut 3 pounds is needed. Therefore the impact load is considered as 50N per hammer. So in this design I am considering 10 coconut shells to grind. So the impact load will be considered as 500N per hammer. in this design 4 hammers are beingused, so impact load (F) on each hammer will be 125N. The power of motor is considered as 5.5KW (7.37HP) to rotate the rotor shaft, which further rotates rotor dics and then hammers.

This section attempts to show the basic equations used in the design of the hammer mill and the principles adopted.

The major components of the machine include the hammers, shaft, bearing, centrifugal fan, mechanical separator, cyclone casing and electric motor

Detailed Design of Hammers

The centrifugal force on the hammers, F_h, is given by

$$F_h = N_h m_h r_h \omega_h^2$$

Where,

F_h = centrifugal force

N_h = number of hammers

m_h = mass of each hammer

r_h = radius of hammer

ω_h = angular velocity of hammer

Assuming inelastic impact between the hammers and material, the velocity of material, V_m, given by

$$V_m = \sqrt{(2 F_h R_h / M_m N_m)}$$

Where

V_m = velocity of material being milled

m_m = mass of material being milled

N_m = number of material impacted

The minimum width of hammer, w_h, to withstand the centrifugal force at impact is given by

$$w_h = d_h + F_h / (t_h + \sigma_h)$$

Where

w_h = width of hammer

d_h = diameter of hammer

t_h = thickness of hammer

σ_h = working stress on hammer

Detailed Design of Power Required by Machine

The power required by the hammer mill, P_{hm}, is given by

$$P_{hm} = T\omega$$

Where

P_{hm} = power

T = torque

ω = angular velocity

Modelling Dimensions

The Modeling Dimensions are calculated according to exiting hammer mill designs. (the given dimension may be vary, these were considered only for modeling purpose not for actual design)

For Rotor shaft

Diameter (d_{rs}): 1.71in.

Length (l_{rs}): 4.00in

ForRotor disc

Inner diameter (d_{ird}): 1.70in.

Outer diameter (d_{ord}):5.00in

Thickness (t_{rd}): 3.00 in

For Hammer arm

Length (l_{ha}): 2.5in

Breadth (b_{ha}):1.5in

Height (h_{ha}):1.5in

Numbers of Arm (n_{ha}): 4

For Hammer head

Length (l_{hh}): 2.5in

Breadth (b_{hh}): 0.5in

Height (h_{hh}): 1.64in

Numbers of head (n_{hh}): 4

ForGrinding chamber
Inner drum dia (D_{igc}): 13.66in

Outer drum dia (D_{ogc}): 16.14in

Length (L_{gc}): 4.00in

ForClosing plate
Diameter (D_{cp}): 16.14in
Thickness (T_{cp}): 0.5in

ForFixed teeths
Length (l_{ft}): 3.00in

Breadth (b_{ft}): 1.0in

Height (h_{ft}): 1.0in

Number of teeth (n_{ft}):10

ForFeeder opening
Length (l_{fo}): 2.22in

Breadth (b_{fo}): 0.5in

Height (h_{fo}): 3.39in

Modelling of Coconut Shell Crushing machine
For the modeling of shaft, rotor disc, hammer arm, hammer head and crushing chamber SOLIDWORKS software is used.

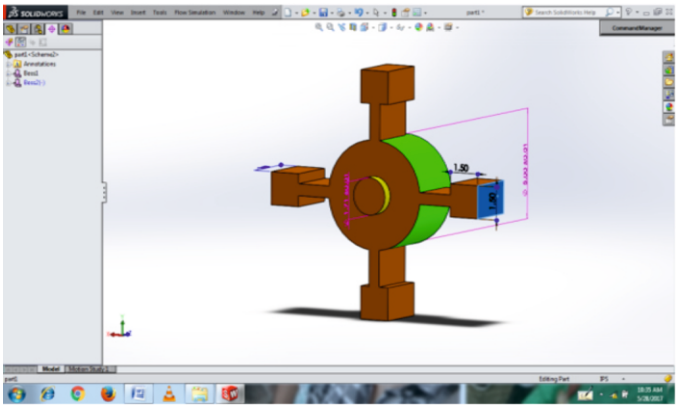


Fig. 2 Modelling of rotor shaft, rotor disc, hammer arm and hammer head

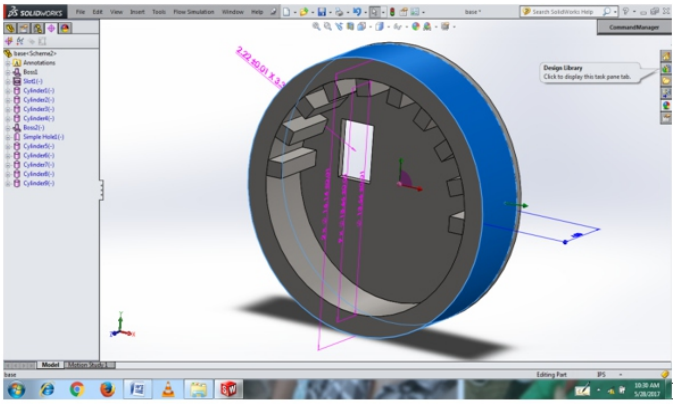


Fig. 3 Modelling of Grinding Chamber with fixed teeths

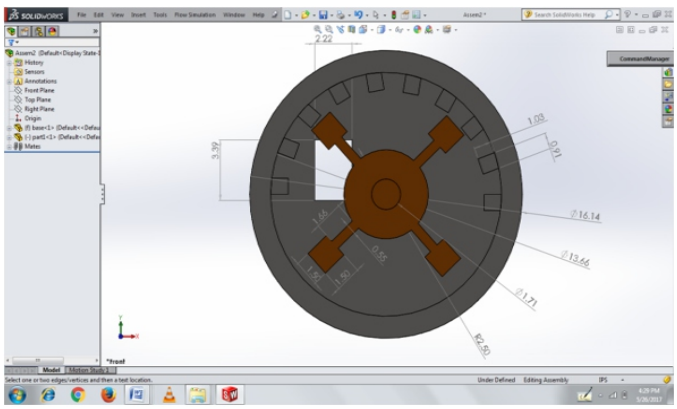


Fig. 4 Modelling of Grinding Chamber with fixed teeths, rotor shaft, Rotor disc, Hammer Head and Hammer Arm assembly

Analysis of Rotor shaft, Rotor disc, Hammer Head and Hammer Arm

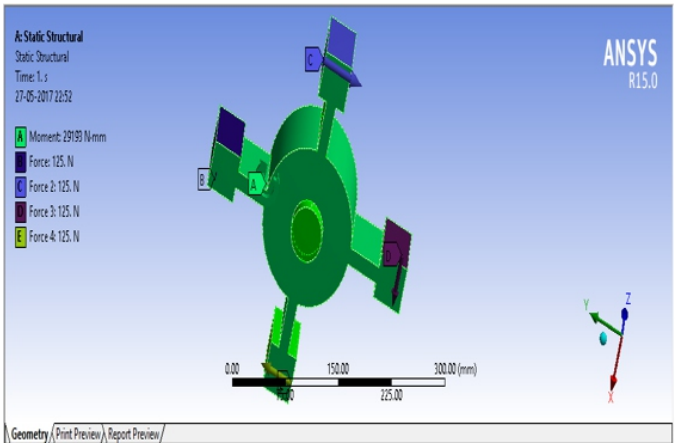


Fig. 5 Static structural anaysis of Rotor shaft, rotor arm, hammer head and hammer arm

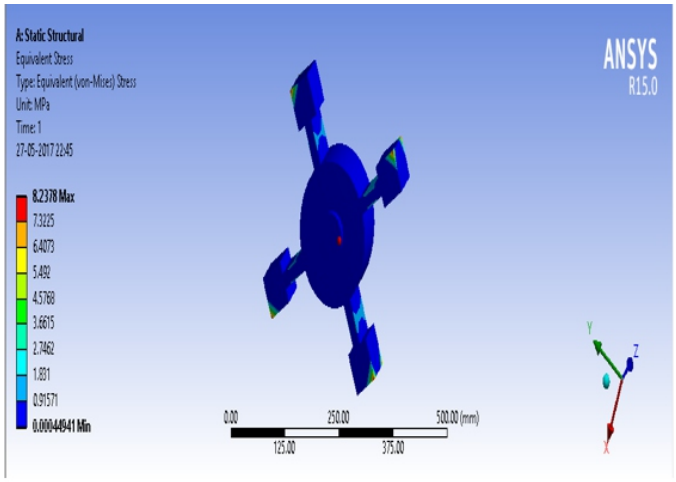


Fig. 6 Equivalent stress anaysis of Rotor shaft, rotor arm, hammer head and hammer arm

5. RESULT AND DISCUSSION

1. The max. Equivalent stress of 8.23MPa and min. Equivalent stress of 4.49 MPa on Rotor shaft, rotor arm, hammer head and hammer arm is calculated.

2. The max. Equivalent elastic strain of 4.11mm/mm and min. Equivalent elastic strain of 8.50mm/mm on Rotor shaft, rotor arm, hammer head and hammer arm is calculated.

3. This design can grind 10 coconut shells at one time feed.

4. This design have a force of 125N(impact load).

5. This design have a moment of 29193N-mm(torque)

Table:1
Equivalent stress AND equivalent elastic strain anaysis of Rotor shaft, rotor arm, hammer head and hammer arm

Object Name	Equivalent Stress	Equivalen+t Elastic Strain
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	

Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	4.4941e-004 MPa	8.5049e-009 mm/mm
Maximum	8.2378 MPa	4.1189e-005 mm/mm
Minimum Value Over Time		
Minimum	4.4941e-004 MPa	8.5049e-009 mm/mm
Maximum	4.4941e-004 MPa	8.5049e-009 mm/mm
Maximum Value Over Time		
Minimum	8.2378 MPa	4.1189e-005 mm/mm
Maximum	8.2378 MPa	4.1189e-005 mm/mm
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

6. CONCLUSION AND FUTURE SCOPE

The temple waste which are the biggest cause of water pollution is produced in a large amount across india. This large amount of temple waste mainly consists of flowers and coconut shell which can not be thrown away due to religious tradition. In this study the temple waste is converted in to the powder form and is utilized for manufacturing of incense sticks/cones by modelling and analysis of a coconut shell grinding machine with the help of using modern design technologies available like CAD, CAE, SOLIDWORKS,ANYSISsoftwares.Through the designing, modelling and analysis of new machine following conclusions are obtained:

Conclusion

1. The max. Equivalent stress on Rotor shaft, rotor arm, hammer head and hammer arm which is made by calculated as 8.23MPa.

2. The max. Equivalent elastic strain on Rotor shaft, rotor arm, hammer head and hammer arm is calculated as 4.11 mm/mm.

3. This design can grind 10 coconut shells at one time feed.

4. This design have a force of 125N(impact load)/ hammer with the moment of 29193N-mm.

5. The size of coconut shell will be obtained of 3-5mm, which is good foe making incense stick/cones.

Future scope

1. This machine can easily be used to contribute in Swachh Bharat Abhiyanto minimize the water and environment pollution problems, due to large construction cost and lack of availability of funds, this report is being sent to Government for their further consideration and to get aid financially.

2. To utilize the temple waste at large amount this machine can easily be used for making incense sticks/cones at small scale for at temple premises.

3. This machine can easily be used to provide employment opportunities by setting up a small scale enterprises at local area level.

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